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ABSTRACT

This lesson plan is intended for use in conducting classes on the effect of pH on plant growth. Presented first are an attention step/problem statement and a series of questions and answers designed to convey general information about soil pH and its effect on plants. The following topics are among those discussed: acidity and alkalinity; the meaning of the numbers on the pH scale, the major components of soils, factors affecting soil pH, the effect of geographic area on pH, the effect of pH on plant growth, sources of plant nutrients, the relationship between soil pH and nutrient availability, the relationship between pH level and bacteria in soil, and methods of increasing and decreasing soil pH. Also provided are the following: a glossary of pertinent scientific terms, 4 worksheets, answers to the worksheets, 2 quizzes, answers to the quizzes, 12 overhead transparency masters, and a lesson plan for teaching students to test the pH of soils. Included in the lesson plan are an objective, list of equipment needed, detailed steps for completing the activity, and student activity record sheet. (MN)

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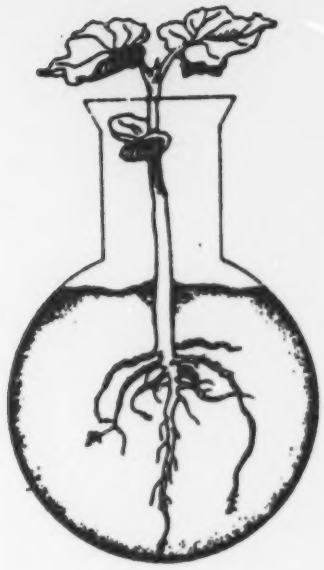

Agricultural Lesson Plans

pH

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Department of
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Southern Illinois University at Carbondale

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ATTENTION STEP/PROBLEM STATEMENT:

Why do the neighbors put coffee grounds on their azalea bushes?

You know what--their azaleas are always more colorful than ours. Answer: Many plants grow best under certain soil pH levels. Azaleas grow best in acidic soils. Coffee grounds help soils become acidic.

1. What are acid compounds ?

   - Acids are chemical compounds containing more hydrogen (H+) than hydroxyl (OH-) ions. Acids have a sour taste. Examples of acids are lemon juice and vinegar.

2. What are Alkaline compounds ?.

   - Alkaline solutions have a greater concentration of hydroxyl (OH-) ions than hydrogen ions (H+). Alkaline solutions are bitter to taste. Soaps made with lye are an example of an alkali.

3. How is the level of acidity measured in soils ?.

   - Determining the acidity or alkalinity of a solution is done by measuring the amount of hydrogen ions present. The pH scale is used to express the degree of acidity or the concentration of hydrogen ions in a solution. The pH scale is a number (logarithmic numbers) scale ranging from 0 - 14.

4. What does 0 on the pH scale represent ?

   - A number of 0 on the pH scale indicates the strongest degree of acidity and highest percentage of hydrogen ions in solution. Any solution testing less than 7 on the pH scale is considered acid.

5. What does the number 14 represent on the pH scale ?

   - A number of 14 on the pH scale indicates the strongest degree of alkalinity and the lowest percentage of hydrogen ions and the highest percentage of hydroxyl ions in solution. Any solution testing more than 7 on the pH scale is considered alkaline.

6. What does the number 7 represent on the pH scale ?
   - A pH of 7 is considered neutral. There are equal numbers of hydrogen ions and hydroxyl ions present in the solution. Pure water is an example of a neutral solution. H2O can be expressed HOH. There are equal amounts of Hydrogen (H+) ions and hydroxyl (OH-) ions in

water.

7. What does the term logarithmic mean ?

Each whole number on the pH scale indicates a tenfold difference in the hydrogen (H+) concentration. For example, a pH of 1 is 10 times more acidic than a pH of 2 and 100 times more acidic than a pH of 3.

8. What are acid compounds ?

Acids are chemical compounds containing more hydrogen (H+) than hydroxyl (OH-) ions. Ions are electrically charged atoms or groups of atoms. Acids have a pH of less than 7.0. The pH is the concentration of hydrogen ions in a solution. A solution is a liquid that contains a dissolved substance. Acids have a sour taste. Examples of acids are lemon juice and vinegar.

9. What are alkaline compounds ?

Alkaline solutions have a greater concentration of hydroxyl (OH-) ions than hydrogen ions (H+). Alkaline solutions have a pH of more than 7.0. Alkaline solutions are bitter to taste. Soaps made with lye are an example of an alkali.

10. What are the major parts of soil ?

Soil is the outer portion of the earth's crust comprised of sand, silt, clay, and organic matter. Sand, silt, and clay make up a soil's texture. Organic matter is decomposed plant or animal matter. All soils can be classified as acidic, alkaline, or neutral.

11. What are three factors which affect soil pH ?

The amount of rainfall received in an area, the amount of organic matter present in the soil, and the texture of the soil effect the pH of the soil.

12. How does the geographic area affect pH ?

Soils in different parts of the country vary in pH. The amount of rainfall in a region effects soil pH. Chemical substances that tend to make the soil alkaline are easily leached from the soil with rainfall. Geographic areas with plentiful rainfall tend to have acidic soils. Geographic areas with very little rainfall tend to have neutral or alkaline soil.

13. How does the number of hydrogen ions affect pH ?

A soil reaction is the amount of acidity or alkalinity in a soil. Soil acidity results from a high percentage of hydrogen ions in the soil solution. The degree of soil acidity increases with an increase in hydrogen ions in the soil solution.

14. How does pH affect plant growth ?

The pH of a soil effects how well plants can grow in it. The pH of a soil effects the amount of elements that are available to plants. An element is any substance that cannot be separated into different substances by ordinary chemical methods.

15. Where do plant nutrients come from ?

Elements (nutrients) in a soil are used by plants. Plants need a total of 16 elements for growth and production of fruit. Thirteen of these elements come from the soil.

16. How does a plant obtain nutrients ?

A plant takes elements up by its root hairs. The root hairs are hair like structures on roots that absorb plant nutrients (elements). Some plants need a certain soil pH for root hairs to grow. Elements in the soil can be used by the plant only when they are in solution and can be absorbed through the root hairs.

17. What happens to the availability of some plant nutrients when the pH is above 7 ?

Some essential elements become unavailable to plants in alkaline soils. Iron, manganese, and zinc are examples of elements that become less available in alkaline soils with a pH of 7.5 or greater.

18. What happens to plant nutrients when pH is acidic ?

Certain elements such as iron, aluminum, and magnesium become toxic to plants in acidic soils.

19. How does the pH level affect bacteria in the soil ?

Bacteria are microscopic organisms that live in the soil and break down organic matter so that it decays. Bacterial activity slows down in acid soils. This slows the breakdown of organic matter and reduces the amount of nitrogen fixing bacteria in the soil. Nitrogen fixing bacteria require a pH above 5.5 to be active.

20. What pH number is most desirable for many plan' ?

Most plants grow best in a pH range between 6.0 to 7.0. Each plant species, or distinct kind of plant, requires different amounts of elements. There is an optimum soil pH range that each plant species grows best.

21. How can I determine the pH level in a sample of soil ?

The pH of a soil can be tested to determine its pH. Soils can be tested using dyes that are mixed with soil and then the solution is matched in color with a color chart to determine the pH of the soil, by using pHydrion papers, or by testing with a pH meter. There are also many commercial soil testing laboratories in the state.

22. What is the pH level of most soils ?

Most soils have a pH between 3 and 9. All soils should be tested to determine its pH before commercial crops should be grown on it.

23. What can be done to decrease soil pH ?

The acidity of the soil can be increased (lowering the pH of the soil) by adding acidic organic matter to the soil, by fertilizing with a fertilizer with an acidic reaction in soils, or by adding sulphur to the soil.

24. What can be done to increase soil pH ?

The alkalinity of the soil can be increased (raising the pH of the soil) by adding lime to the soil.

25. How do organic matter levels and texture affect the amount of material needed to alter a soils pH ?

The amount of organic matter and texture of the soil effects the amount of material needed to alter the pH of a soil. Soils that are high in organic matter or are comprised of heavy clay have a high degree of buffering capacity. These soils need greater amounts of material to alter the pH than

sandy soils.

GLOSSARY OF SCIENTIFIC TERMS:

acid -	pH of less than 7.
alkaline -	pH of more than 7.
bacteria -	Microscopic organisms that live in the soil and break down organic matter so that it decays.
elements -	Any substance that cannot be separated into different substances by ordinary chemical methods.
ion -	An electrically charged atom or group of atoms.
neutral -	pH of 7.0.
organic matter -	Decomposed plant or animal material.
pH -	The concentration of hydrogen ions in a solution.
pH scale -	Measures the acidity or alkalinity of a solution using a logarithmic scale from 0 - 14.
plant species -	A distinct kind of plant.
root hairs -	Hair like structures on roots that absorb plant nutrients (elements).
soil -	The outer portion of the earth's crust comprised of sand, silt, clay, and organic matter.
soil reaction -	The amount of acidity or alkalinity in a soil.
soil texture -	The size of the 3 mineral particles found in soil: sand, silt, and clay.
solution -	Liquid that contains a dissolved substance.

WORK SHEET A

Directions: Complete the following questions.

A. Fill-in-the-Blank:

1. Acids are chemical compounds that have a high concentration of _____ ions.

2. A number of _____ on the pH scale indicates the strongest degree of acidity.

3. Solutions that have a pH of less than _____ are considered acidic.

4. A solution that has a pH of 7 is considered _____.

5. Alkaline solutions have a low concentration of _____ ions.

6. A number of _____ on the pH scale indicates the strongest degree of alkalinity.

7. Solutions that have a pH of more that _____ are considered alkaline.

8. A neutral solution has equal numbers of hydrogen ions and _____ ions.

9. A pH of 9 is 10 times more alkaline that a pH of _____.

10. A pH of 4 is _____ times more acidic than a pH of 6.

WORK SHEET B

Directions:

The answers to the following fill-in-the-blank questions are terms which have to do with the pH of soils. Choose the term from the word list below that best answers each question. Each term may be used only once.

Word List:

acid
alkaline
bacteria
elements
ions
neutral
organic matter
pH
pH scale
plant species
root hairs
solution
soil
soil reaction
soil texture

Fill-in-the-blank:

1. The hair-like structures on roots that absorb plant nutrients are called _____.

2. A liquid that contains a dissolved substance is called a _____.

3. The _____ measures the acidity or alkalinity of a solution using a logarithmic scale from 0 - 14.

4. _____ refers to the amount of acidity or alkalinity in a soil.

5. A solution is _____ if it has a pH of 7.0.

6. An _____ has a pH of less than 7.

7. If a solution has a pH of more than 7 it is called _____.

8. _____ refers to the concentration of hydrogen ions in a solution.

9. _____ is the outer portion of the earth's crust.

10. The size of the three mineral particles found in the soil is called _____.

11. _____ is decomposed plant or animal matter.

12. A distinct kind of plant is called a _____.

13. _____ are microscopic organisms that live in the soil and break down organic matter so it decays.

14. An _____ is any substance that cannot be separated into different substances by ordinary chemical methods.

15. An electrically charged atom or group of atoms are called _____.

WORK SHEET C

Directions: Complete the following questions.

A. Fill-in-the-blank:

1. Soil is made up of _____, _____, _____, and organic matter.

2. Soil acidity results from a high percentage of _____ ions in the soil solution.

3. Geographic areas with little rainfall tend to have _____ or neutral soils.

4. Geographic areas with plentiful rainfall tend to have _____ soils.

5. The pH of a soil affects the amount of _____ available to the plant.

6. A plant takes elements up by its _____.

7. Elements in the soil can be used by the plant only when they are in _____.

8. Elements can become _____ or _____ to plants if the soil pH is extremely acidic or alkaline.

9. The alkalinity of the soil can be increased by adding _____ to the soil.

10. All soils should be _____ to determine its pH before commercial crops should be grown on it.

11. Most plants grow best at a pH range of _____ to _____.

B. Short Answer:

12. List 3 conditions that affect the pH of a soil.

a. _____

b. _____

c. _____

13. List 3 ways to increase the acidity of a soil.

a. _____

b. _____

c. _____

WORK SHEET D: STUDENT REVIEW

1. What is the acidity range on the pH scale?
2. What is the alkalinity range on the pH scale?
3. What is the best soil pH range for most plants?
4. When are some elements toxic to plants?
5. When are some elements unavailable to plants?
6. At what pH are soils considered neutral?
7. What is the soil made of?
8. Explain the difference between acidic and alkaline solutions.
9. What conditions affect the pH of a soil?
10. How do plants take up elements from the soil?
11. Describe 3 methods that can be used for testing the pH of soil.
12. Describe one method used to raise soil pH.
13. Describe three methods used to lower soil pH.

WORK SHEET A

Directions: Complete the following questions.

A. Fill-in-the-Blank:

1. Acids are chemical compounds that have a high concentration of ___*hydrogen*___ ions.

2. A number of ___*0*___ on the pH scale indicates the strongest degree of acidity.

3. Solutions that have a pH of less than ___*7*___ are considered acidic.

4. A solution that has a pH of 7 is considered ___*neutral*___.

5. Alkaline solutions have a low concentration of ___*hydrogen*___ ions.

6. A number of ___*14*___ on the pH scale indicates the strongest degree of alkalinity.

7. Solutions that have a pH of more that ___*7*___ are considered alkaline.

8. A neutral solution has equal numbers of hydrogen ions and ___*hydroxyl*___ ions.

9. A pH of 9 is 10 times more alkaline that a pH of ___*8*___.

10. A pH of 4 is ___*100*___ times more acidic than a pH of 6.

WORK SHEET B

Directions:

The answers to the following fill-in-the-blank questions are terms which have to do with the pH of soils. Choose the term from the word list below that best answers each question. Each term may be used only once.

Word List:

acid
alkaline
bacteria
elements
ions
neutral
organic matter
pH
pH scale
plant species
root hairs
solution
soil
soil reaction
soil texture

Fill-in-the-blank:

1. The hair-like structures on roots that absorb plant nutrients are called ___*root hairs*___.
2. A liquid that contains a dissolved substance is called a ___*solution*___.
3. The ___*pH scale*___ measures the acidity or alkalinity of a solution using a logarithmic scale from 0 - 14.
4. ___*Soil reaction*___ refers to the amount of acidity or alkalinity in a soil.
5. A solution is ___*neutral*___ if it has a pH of 7.0.
6. An ___*acid*___ has a pH of less than 7.
7. If a solution has a pH of more than 7 it is called ___*alkaline*___.
8. ___*pH*___ refers to the concentration of hydrogen ions in a solution.
9. ___*Soil*___ is the outer portion of the earth's crust.
10. The size of the three mineral particles found in the soil is called ___*soil texture*___.
11. ___*Organic matter*___ is decomposed plant or animal matter.
12. A distinct kind of plant is called a ___*plant species*___.
13. ___*Bacteria*___ are microscopic organisms that live in the soil and break down organic matter so it decays.
14. An ___*element*___ is any substance that cannot be separated into different substances by ordinary chemical methods.
15. An electrically charged atom or group of atoms are called ___*ion(s)*___.

WORK SHEET C Directions: Complete the following questions.

A. Fill-in-the-blank:

1. Soil is made up of ___*sand*___, ___*silt*___, ___*clay*___, and organic matter.

2. Soil acidity results from a high percentage of ___*hydrogen*___ ions in the soil solution.

3. Geographic areas with little rainfall tend to have ___*alkaline*___ or neutral soils.

4. Geographic areas with plentiful rainfall tend to have ___*acidic*___ soils.

5. The pH of a soil affects the amount of ___*elements*___ available to the plant.

6. A plant takes elements up by its ___*root hairs*___.

7. Elements in the soil can be used by the plant only when they are in ___*solution*___.

8. Elements can become ___*unavailable*___ or ___*toxic*___ to plants if the soil pH is extremely acidic or alkaline.

9. The alkalinity of the soil can be increased by adding ___*lime*___ to the soil.

10. All soils should be ___*tested*___ to determine its pH before commercial crops should be grown on it.

11. Most plants grow best at a pH range of ___*6.0*___ to ___*7.0*___.

12. List 3 conditions that affect the pH of a soil.

    a. ___*the amount of rainfall received in an area*___.
    b. ___*the amount of organic matter present in the soil*___.
    c. ___*the texture of the soil*___.

13. List 3 ways to increase the acidity of a soil.

    a. ___*add acidic organic matter to the soil*___.
    b. ___*fertilize with as fertilizer that has an acidic reaction in soils*___.
    c. ___*add sulphur to the soil*___

WORK SHEET D: STUDENT REVIEW

1. What is the acidity range on the pH scale?
   The acidity range on the pH scale ranges from <7 to 0.

2. What is the alkalinity range on the pH scale?
   The alkalinity range on the pH scale ranges from >7 to 14.

3. What is the best soil pH range for most plants?
   Most plants grow best at a pH between 6.0 and 7.0.

4. When are some elements toxic to plants?
   Some elements are toxic to plants in acidic soils.

5. When are some elements unavailable to plants?
   Some elements are unavailable to plants in alkaline soils.

6. At what pH are soils considered neutral?
   Any soil solution with a pH of 7 is classified as neutral.

7. What is the soil made of?
   Soil is made up of sand, silt, clay, and organic matter.

8. Explain the difference between acidic and alkaline solutions.
   Acidic solutions have a sour taste and contain more hydrogen ions than hydroxyl ions. Alkaline solutions have a bitter taste and contain more hydroxyl ions than hydrogen ions.

9. What conditions affect the pH of a soil?
   The amount of rainfall received in an area, the amount of organic matter present in the soil, and the texture of the soil affect the pH of the soil.

10. How do plants take up elements from the soil?
    A plant takes elements up by its root hairs.

11. Describe 3 methods that can be used for testing the pH of soil. ?
Soils can be tested using dyes that are mixed with soil and then the solution is matched in color with a color chart to determine the pH of the soil. Testing can also be done using pHydrion Papers or by testing with a pH meter.

12. Describe one method used to raise soil pH.
    Lime can be applied to a soil to raise its pH.

13. Describe three methods used to lower soil pH.
    The pH of a soil can be lowered by adding acidic organic matter to the soil, by fertilizing with a fertilizer with an acidic reaction in soils, or by adding sulphur to the soil.

QUIZ 1

A. Matching:

Match the best definition with each term:

_____1.	pH	a.	the size of 3 mineral particles found in soil: sand, silt, clay.
_____2.	soil texture	b.	electronically charged atom
_____3.	soil	c.	measures the acidity or alkalinity of a solution using a logarithmic scale from 0 - 14.
_____4.	ion	d.	outer portion of earth's crust made up of sand,silt, clay and organic particles.

B. True or False:

_____ 5. At a pH of 7, there are equal numbers of hydrogen and hydroxyl ions present in the solution.

_____ 6. Some elements are toxic to plants at a low soil pH.

_____ 7. Some elements are unavailable to plants at a high soil pH.

C. Fill-in-the-blank:

8. Acidic solutions have a sour taste and contain more _____ ions than hydroxyl ions.

9. A plant takes elements from the soil water by its _____ .

D. Short Answer:

10. Name 3 conditions that affect the pH of a soil.

a.
b.
c.

QUIZ 2

A. Matching:

Match the best definition with each term.

_____	1. neutral	a. concentration of hydrogen ions in a solution
_____	2. alkaline	b. pH under 7
_____	3. acid	c. pH of 7.0
_____	4. soil reaction	d. amount of acidity or alkalinity in a soil
_____	5. pH	e. pH over 7

B. Fill-in-the-blank:

6. _____ should be added to a soil to increase its alkalinity.

7. The acidity of the soil can be increased by adding organic matter to the soil, by fertilizing with a fertilizer that has an acidic reaction to the soils, or by adding _____ to the soil.

8. Most plants grow best at a soil pH between _____ and _____ .

C. Short answer:

9. List 3 ways the pH of a soil can be tested.

a.

b.

c.

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QUIZ 1

A. Matching:

Match the best definition with each term:

c	1. pH	a.	the size of 3 mineral particles found in soil: sand, silt, clay.
a	2. soil texture	b.	electronically charged atom
d	3. soil	c.	measures the acidity or alkalinity of a solution using a logarithmic scale from 0 - 14.
b	4. ion	d.	outer portion of earth's crust made up of sand,silt, clay and organic particles.

B. True or False:

T 5. At a pH of 7, there are equal numbers of hydrogen and hydroxyl ions present in the solution.

T 6. Some elements are toxic to plants at a low soil pH.

T 7. Some elements are unavailable to plants at a high soil pH.

C. Fill-in-the-blank:

8. Acidic solutions have a sour taste and contain more *hydrogen* ions than hydroxyl ions.

9. A plant takes elements from the soil water by its *root hairs*.

D. Short Answer:

10. Name 3 conditions that affect the pH of a soil.

a. *amount of rainfall received in a geographic area*

b. *amount of organic matter present in the soil*

c. *texture of the soil*

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QUIZ 2

A. Matching:

Match the best definition with each term.

c	1. neutral	a.	concentration of hydrogen ions in a solution
e	2. alkaline	b.	pH under 7
b	3. acid	c.	pH of 7.0
d	4. soil reaction	d.	amount of acidity or alkalinity in a soil
a	5. pH	e.	pH over 7

B. Fill-in-the-blank:

6. *Lime* should be added to a soil to increase its alkalinity.

7. The acidity of the soil can be increased by adding organic matter to the soil, by fertilizing with a fertilizer that has an acidic reaction to the soils, or by adding *sulphur* to the soil.

8. Most plants grow best at a soil pH between *6.0* and *7.0* .

C. Short answer:

9. List 3 ways the pH of a soil can be tested.

   a. *by using dyes that are mixed with soil and then the solution is matched in color with a color chart*

   b. *using pHydrion papers*

   c. *testing with a pH meter*

STUDENT ACTIVITY - INFORMATION SHEET

Testing the pH of soils.

a. **Purpose:** To determine if pH is suitable for growing crop.

b. **What Each Student Needs:**
4 soil samples (slightly moistened)
tube of soiltex solution
soiltex pH papers
soiltex pH chart

c. **Here's How:**

1. Your teacher will assign 4 soil samples for you to test. Write the names of the soil samples on your record sheet.

2. Carry a small amount of a soil sample, about 1/4 teaspoon, back to your work area.

3. Get one soiltex pH waxed paper.

4. Fold soiltex waxed paper in half lengthwise. Then fold up outer end and open to form a small paper boat.

5. Place a small amount of soil (about the size of 3 drops) in the middle of the paper boat.

6. Add 8 - 10 drops of the soiltex solution to the middle of the paper boat.

7. Shake the paper endwise until the color of the liquid remains constant--about one-half minute.

8. Shake the soil to the back end and let the liquid run to the front end.

9. Compare the color of the liquid with the color chart for pH or soil reaction. If the liquid is muddy, allow the soil particles to settle before reading.

10. Find the color of the soiltex Color Chart that best matches the color of the liquid.

11. Record the pH number and soil reaction of the liquid on your Student Activity - 1 Record Sheet.

12. Throw away tested soil liquid in trash can.

13. Repeat soil testing process with your other 3 samples and record results on Student Activity - 1 Record Sheet.

14. Clean up your mess.

STUDENT ACTIVITY - 1
RECORD SHEET

A. Record Data Here:

Soil Samples	pH	Soil Reaction
1.		
2.		
3.		
4.		

B. Answer Questions:

1. Which soil sample was the most acidic?

2. How would you increase the pH of the soil sample you named in #1?

3. Which sample was the most alkaline?

4. How could you lower the pH of the soil sample you named in #3?

C. Conclusions:

FAVORABLE pH RANGE FOR THESE PLANTS:

Plant	pH
Alfalfa	6.0 - 7.0
Apple	6.0 - 7.0
Azalea	4.5 - 5.8
Beans, Lima	5.5 - 6.5
Blueberries	4.2 - 5.2
Clover, Red	6.0 - 7.0
Corn	6.0 - 7.0
Grapes	5.0 - 6.5
Hydrangea-Blue	4.5 - 5.3
Iris, BlueFlag	5.0 - 7.5
Peas	6.0 - 7.5
Peppers	5.5 - 6.5
Potato	5.0 - 5.5
Soybeans	6.0 - 7.0
Strawberries	5.0 - 7.5
Tomato	6.0 - 7.0

5. Using the information from the table on "Favorable pH Range for These Plants", list 2 plants that could be successfully grown in each soil sample.

Soil sample		Suitable Plants
#1	1.	
	2.	
#2	1.	
	2.	
#3	1.	
	2.	
#4	1.	
	2.	

6. Of the plants listed in the table above, which ones need the most acidic soils?

7. Which plants can tolerate the most alkaline conditions?

ACIDS:

1. Contain more hydrogen (H+) than hydroxyl (OH-) ions

2. Taste sour

25

ALKALINE SOLUTIONS:

1. Have a greater concentration of hydroxyl (OH-) ions than hydrogen (H+) ions

2. Taste bitter

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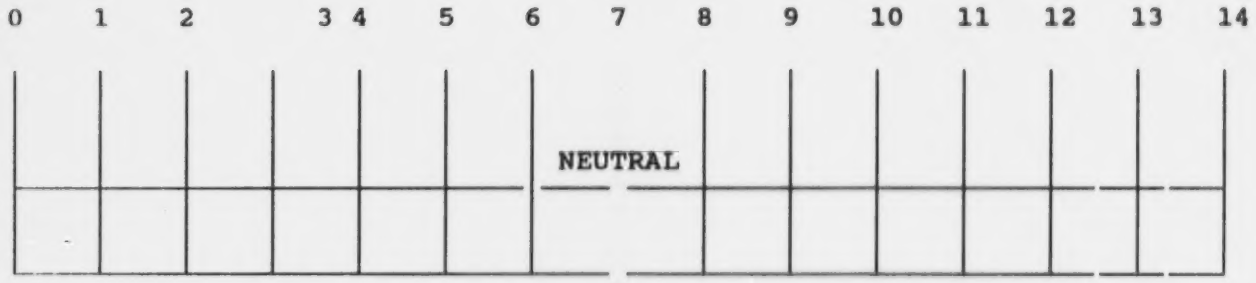
pH SCALE



Increasing acidity and hydrogen ions

Increasing alkalinity and hydroxyl ions

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H+ AND OH- CONCENTRATION AT VARYING pH

pH	Soil reaction	H+*	OH-**
		Concentration (moles per l)	
0		10^{-0}	10^{-14}
1		10^{-1}	10^{-13}
2		10^{-2}	10^{-12}
3	very strong acid	10^{-3}	10^{-11}
4	strong acid	10^{-4}	10^{-10}
5	moderately acid	10^{-5}	10^{-9}
6	slightly acid	10^{-6}	10^{-8}
7	neutral	10^{-7}	10^{-7}
8	slightly alkaline	10^{-8}	10^{-6}
9	moderately alkaline	10^{-9}	10^{-5}
10	strong alkaline	10^{-10}	10^{-4}
11	very strong alkaline	10^{-11}	10^{-3}
12		10^{-12}	10^{-2}
13		10^{-13}	10^{-1}
14		10^{-14}	10^{-0}

* 1 mole of H = 1 g
** 1 mole of OH = 17 g

SOIL CONTAINS:

Sand

Silt

Clay

Organic Matter

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CONDITIONS THAT AFFECT SOIL pH:

Amount of rainfall

Amount of organic matter

Texture of the soil

30

SOIL pH AFFECTS:

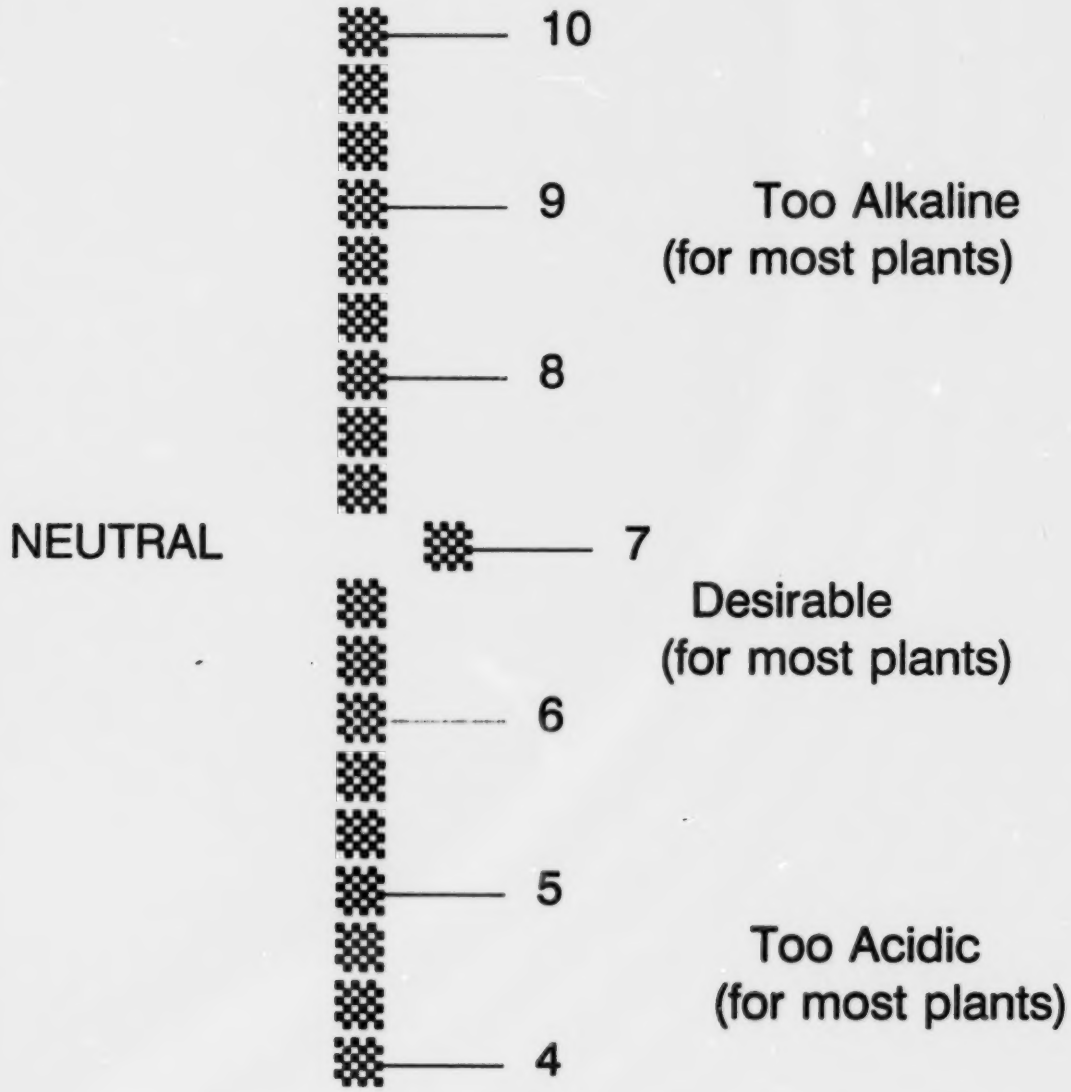
Amount of elements available to plants

How well root hairs grow

31

pH RANGE

FOR MOST PLANTS



IN ACIDIC SOILS:

Some elements are toxic to plants

Bacterial activity slows

33

METHODS TO TEST SOIL pH:

1. Mix dye with soil and use color chart

2. pHydrion papers

3. pH meter

TO INCREASE SOIL ACIDITY:

1. Add organic matter

2. Fertilize with a fertilizer with an acidic reaction

3. Add sulphur

35

TO INCREASE SOIL ALKALINITY:

1. Add lime

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